

SEQUENCE LISTING

(1) GENERAL INFORMATION:

- (i) APPLICANT: Loeb, Lawrence A.
Hood, Leroy
Suzuki, Motoshi
- (ii) TITLE OF INVENTION: Thermostable Polymerases Having Altered Fidelity and Methods of Identifying and Using Same
- (iii) NUMBER OF SEQUENCES: 11
- (iv) CORRESPONDENCE ADDRESS:
 - (A) ADDRESSEE: CAMPBELL & FLORES LLP
 - (B) STREET: 4370 La Jolla Village Drive, Suite 700
 - (C) CITY: San Diego
 - (D) STATE: California
 - (E) COUNTRY: United States
 - (F) ZIP: 92121
- (v) COMPUTER READABLE FORM:
 - (A) MEDIUM TYPE: Floppy disk
 - (B) COMPUTER: IBM PC compatible
 - (C) OPERATING SYSTEM: PC-DOS/MS-DOS
 - (D) SOFTWARE: PatentIn Release #1.0, Version #1.25
- (vi) CURRENT APPLICATION DATA:
 - (A) APPLICATION NUMBER: US 08/978,806
 - (B) FILING DATE: 26-NOV-1997
 - (C) CLASSIFICATION:
- (vii) PRIOR APPLICATION DATA:
 - (A) APPLICATION NUMBER: US 60/031,496
 - (B) FILING DATE: 27-NOV-1996
- (viii) ATTORNEY/AGENT INFORMATION:
 - (A) NAME: Campbell, Cathryn A.
 - (B) REGISTRATION NUMBER: 31,815
 - (C) REFERENCE/DOCKET NUMBER: P-UW 2873
- (ix) TELECOMMUNICATION INFORMATION:
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 - (B) TELEFAX: (619)535-8949

(2) INFORMATION FOR SEQ ID NO:1:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 2626 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: both
 - (D) TOPOLOGY: linear

- (ix) FEATURE:
 - (A) NAME/KEY: CDS
 - (B) LOCATION: 121..2616

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:1:

AAGCTCAGAT CTACCTGCCT GAGGGCGTCC GGTTCAGCT GGCCCTTCCC GAGGGGGAGA 60
 GGGAGGCGTT TCTAAAAGCC CTTCAGGACG CTACCCGGGG GCGGGTGGTG GAAGGGTAAC 120

ATG Met 1	AGG Arg	GGG Gly	ATG Met	CTG Leu 5	CCC Pro	CTC Leu	TTT Phe	GAG Glu	CCC Pro 10	AAG Lys	GGC Gly	CGG Arg	GTC Val	CTC Leu 15	CTG Leu	168
GTG Val	GAC Asp	GGC Gly	CAC His 20	CAC His	CTG Leu	GCC Ala	TAC Tyr 25	CGC Arg	ACC Thr	TTC Phe	CAC His	GCC Ala	CTG Leu 30	AAG Lys	GGC Gly	216
CTC Leu	ACC Thr 35	ACC Thr	AGC Ser	CGG Arg	GGG Gly	GAG Glu 40	CCG Pro	GTG Val	CAG Gln	GCG Ala	GTC Val 45	TAC Tyr	GGC Gly	TTC Phe	GCC Ala	264
AAG Lys 50	AGC Ser	CTC Leu	CTC Leu	AAG Lys	GCC Ala 55	CTC Leu	AAG Lys	GAG Glu	GAC Asp	GGG Gly 60	GAC Asp	GCG Ala	GTG Val	ATC Ile	GTG Val	312
GTC Val 65	TTT Phe	GAC Asp	GCC Ala	AAG Lys 70	GCC Ala 70	CCC Pro	TCC Ser	TTC Phe	CGC Arg	CAC His 75	GAG Glu	GCC Ala	TAC Tyr	GGG Gly 80	GGG Gly	360
TAC Tyr	AAG Lys	GCG Ala	GGC Gly 85	CGG Arg 85	GCC Ala	CCC Pro	ACG Thr	CCG Pro	GAG Glu 90	GAC Asp	TTT Phe	CCC Pro	CGG Arg	CAA Gln 95	CTC Leu	408
GCC Ala	CTC Leu	ATC Ile	AAG Lys 100	GAG Glu	CTG Leu	GTG Val	GAC Asp	CTC Leu 105	CTG Leu	GGG Gly	CTG Leu	GCG Ala	CGC Arg 110	CTC Leu	GAG Glu	456
GTC Val	CCG Pro	GGC Gly 115	TAC Tyr	GAG Glu	GCG Ala	GAC Asp	GAC Asp 120	GTC Val	CTG Leu	GCC Ala	AGC Ser	CTG Leu 125	GCC Ala	AAG Lys	AAG Lys	504
GCG Ala 130	GAA Glu	AAG Lys	GAG Glu	GGC Gly	TAC Tyr	GAG Glu 135	GTC Val	CGC Arg	ATC Ile	CTC Leu	ACC Thr 140	GCC Ala	GAC Asp	AAA Lys	GAC Asp	552
CTT Leu 145	TAC Tyr	CAG Gln	CTC Leu	CTT Leu	TCC Ser 150	GAC Asp	CGC Arg	ATC Ile	CAC His	GTC Val 155	CTC Leu	CAC His	CCC Pro	GAG Glu 160	GGG Gly	600
TAC Tyr	CTC Leu	ATC Ile	ACC Thr 165	CCG Pro	GCC Ala	TGG Trp	CTT Leu	TGG Trp	GAA Glu 170	AAG Lys	TAC Tyr	GGC Gly	CTG Leu 175	AGG Arg	CCC Pro	648
GAC Asp	CAG Gln	TGG Trp	GCC Ala 180	GAC Asp	TAC Tyr	CGG Arg	GCC Ala 185	CTG Leu	ACC Thr	GGG Gly	GAC Asp	GAG Glu	TCC Ser 190	GAC Asp	AAC Asn	696
CTT Leu	CCC Pro	GGG Gly 195	GTC Val	AAG Lys	GGC Gly	ATC Ile	GGG Gly 200	GAG Glu	AAG Lys	ACG Thr	GCG Ala	AGG Arg 205	AAG Lys	CTT Leu	CTG Leu	744
GAG Glu 210	GAG Glu	TGG Trp	GGG Gly	AGC Ser	CTG Leu	GAA Glu 215	GCC Ala	CTC Leu	CTC Leu	AAG Lys	AAC Asn 220	CTG Leu	GAC Asp	CGG Arg	CTG Leu	792
AAG Lys 225	CCC Pro	GCC Ala	ATC Ile	CGG Arg	GAG Glu 230	AAG Lys	ATC Ile	CTG Leu	GCC Ala	CAC His 235	ATG Met	GAC Asp	GAT Asp	CTG Leu	AAG Lys 240	840
CTC Leu	TCC Ser	TGG Trp	GAC Asp 245	CTG Leu	GCC Ala	AAG Lys	GTG Val	CGC Arg	ACC Thr 250	GAC Asp	CTG Leu	CCC Pro	CTG Leu	GAG Glu 255	GTG Val	888
GAC Asp	TTC Phe	GCC Ala	AAA Lys 260	AGG Arg	CGG Arg	GAG Glu	CCC Pro	GAC Asp 265	CGG Arg	GAG Glu	AGG Arg	CTT Leu	AGG Arg	GCC Ala	TTT Phe	936

CTG	GAG	AGG	CTT	GAG	TTT	GGC	AGC	CTC	CTC	CAC	GAG	TTC	GGC	CTT	CTG	984
Leu	Glu	Arg	Leu	Glu	Phe	Gly	Ser	Leu	Leu	His	Glu	Phe	Gly	Leu	Leu	
		275					280					285				
GAA	AGC	CCC	AAG	GCC	CTG	GAG	GAG	GCC	CCC	TGG	CCC	CCG	CCG	GAA	GGG	1032
Glu	Ser	Pro	Lys	Ala	Leu	Glu	Glu	Ala	Pro	Trp	Pro	Pro	Pro	Glu	Gly	
		290				295					300					
GCC	TTC	GTG	GGC	TTT	GTG	CTT	TCC	CGC	AAG	GAG	CCC	ATG	TGG	GCC	GAT	1080
Ala	Phe	Val	Gly	Phe	Val	Leu	Ser	Arg	Lys	Glu	Pro	Met	Trp	Ala	Asp	
					310					315					320	
CTT	CTG	GCC	CTG	GCC	GCC	GCC	AGG	GGG	GGC	CGG	GTC	CAC	CGG	GCC	CCC	1128
Leu	Leu	Ala	Leu	Ala	Ala	Ala	Arg	Gly	Gly	Arg	Val	His	Arg	Ala	Pro	
				325					330					335		
GAG	CCT	TAT	AAA	GCC	CTC	AGG	GAC	CTG	AAG	GAG	GCG	CGG	GGG	CTT	CTC	1176
Glu	Pro	Tyr	Lys	Ala	Leu	Arg	Asp	Leu	Lys	Glu	Ala	Arg	Gly	Leu	Leu	
			340					345					350			
GCC	AAA	GAC	CTG	AGC	GTT	CTG	GCC	CTG	AGG	GAA	GGC	CTT	GGC	CTC	CCG	1224
Ala	Lys	Asp	Leu	Ser	Val	Leu	Ala	Leu	Arg	Glu	Gly	Leu	Gly	Leu	Pro	
		355					360					365				
CCC	GGC	GAC	GAC	CCC	ATG	CTC	CTC	GCC	TAC	CTC	CTG	GAC	CCT	TCC	AAC	1272
Pro	Gly	Asp	Asp	Pro	Met	Leu	Leu	Ala	Tyr	Leu	Leu	Asp	Pro	Ser	Asn	
		370				375					380					
ACC	ACC	CCC	GAG	GGG	GTG	GCC	CGG	CGC	TAC	GGC	GGG	GAG	TGG	ACG	GAG	1320
Thr	Thr	Pro	Glu	Gly	Val	Ala	Arg	Arg	Tyr	Gly	Gly	Glu	Trp	Thr	Glu	
					390					395					400	
GAG	GCG	GGG	GAG	CGG	GCC	GCC	CTT	TCC	GAG	AGG	CTC	TTC	GCC	AAC	CTG	1368
Glu	Ala	Gly	Glu	Arg	Ala	Ala	Leu	Ser	Glu	Arg	Leu	Phe	Ala	Asn	Leu	
				405					410					415		
TGG	GGG	AGG	CTT	GAG	GGG	GAG	GAG	AGG	CTC	CTT	TGG	CTT	TAC	CGG	GAG	1416
Trp	Gly	Arg	Leu	Glu	Gly	Glu	Glu	Arg	Leu	Leu	Trp	Leu	Tyr	Arg	Glu	
			420					425					430			
GTG	GAG	AGG	CCC	CTT	TCC	GCT	GTC	CTG	GCC	CAC	ATG	GAG	GCC	ACG	GGG	1464
Val	Glu	Arg	Pro	Leu	Ser	Ala	Val	Leu	Ala	His	Met	Glu	Ala	Thr	Gly	
		435					440					445				
GTG	CGC	CTG	GAC	GTG	GCC	TAT	CTC	AGG	GCC	TTG	TCC	CTG	GAG	GTG	GCC	1512
Val	Arg	Leu	Asp	Val	Ala	Tyr	Leu	Arg	Ala	Leu	Ser	Leu	Glu	Val	Ala	
		450				455					460					
GAG	GAG	ATC	GCC	CGC	CTC	GAG	GCC	GAG	GTC	TTC	CGC	CTG	GCC	GGC	CAC	1560
Glu	Glu	Ile	Ala	Arg	Leu	Glu	Ala	Glu	Val	Phe	Arg	Leu	Ala	Gly	His	
					470					475					480	
CCC	TTC	AAC	CTC	AAC	TCC	CGG	GAC	CAG	CTG	GAA	AGG	GTC	CTC	TTT	GAC	1608
Pro	Phe	Asn	Leu	Asn	Ser	Arg	Asp	Gln	Leu	Glu	Arg	Val	Leu	Phe	Asp	
				485					490					495		
GAG	CTA	GGG	CTT	CCC	GCC	ATC	GGC	AAG	ACG	GAG	AAG	ACC	GGC	AAG	CGC	1656
Glu	Leu	Gly	Leu	Pro	Ala	Ile	Gly	Lys	Thr	Glu	Lys	Thr	Gly	Lys	Arg	
			500					505					510			
TCC	ACC	AGC	GCC	GCC	GTC	CTG	GAG	GCC	CTC	CGC	GAG	GCC	CAC	CCC	ATC	1704
Ser	Thr	Ser	Ala	Ala	Val	Leu	Glu	Ala	Leu	Arg	Glu	Ala	His	Pro	Ile	
		515					520					525				
GTG	GAG	AAG	ATC	CTG	CAG	TAC	CGG	GAG	CTC	ACC	AAG	CTG	AAG	AGC	ACC	1752
Val	Glu	Lys	Ile	Leu	Gln	Tyr	Arg	Glu	Leu	Thr	Lys	Leu	Lys	Ser	Thr	
		530				535					540					

TAC Tyr 545	ATT Ile	GAC Asp	CCC Pro	TGT Leu	CCG Pro 550	GAC Asp	CTC Leu	ATC Ile	CAC His	CCC Pro 555	AGG Arg	ACG Thr	GGC Gly	CGC Arg	CTC Leu 560	1800
CAC His	ACC Thr	CGC Arg	TTC Phe	AAC Asn 565	CAG Gln	ACG Thr	GCC Ala	ACG Thr	GCC Ala 570	ACG Thr	GGC Gly	AGG Arg	CTA Leu	AGT Ser 575	AGC Ser	1848
TCC Ser	GAT Asp	CCC Pro	AAC Asn 580	CTC Leu	CAG Gln	AAC Asn	ATC Ile	CCC Pro 585	GTC Val	CGC Arg	ACC Thr	CCG Pro	CTT Leu 590	GGG Gly	CAG Gln	1896
AGG Arg	ATC Ile	CGC Arg 595	CGG Arg	GCC Ala	TTC Phe	ATC Ile	GCC Ala 600	GAG Glu	GAG Glu	GGG Gly	TGG Trp	CTA Leu 605	TTG Leu	GTG Val	GCC Ala	1944
CTG Leu 610	GAC Asp	TAT Tyr	AGC Ser	CAG Gln	ATA Ile	GAG Glu 615	CTC Leu	AGG Arg	GTG Val	CTG Leu 620	GCC Ala	CAC His	CTC Leu	TCC Ser	GGC Gly	1992
GAC Asp 625	GAG Glu	AAC Asn	CTG Leu	ATC Ile	CGG Arg 630	GTC Val	TTC Phe	CAG Gln	GAG Glu 635	GGG Gly	CGG Arg	GAC Asp	ATC Ile	CAC His	ACG Thr 640	2040
GAG Glu	ACC Thr	GCC Ala	AGC Ser	TGG Trp 645	ATG Met	TTC Phe	GGC Gly	GTC Val	CCC Pro 650	CGG Arg	GAG Glu	GCC Ala	GTG Val	GAC Asp 655	CCC Pro	2088
CTG Leu	ATG Met	CGC Arg 660	CGG Arg	GCG Ala	GCC Ala	AAG Lys	ACC Thr	ATC Ile 665	AAC Asn	TTC Phe	GGG Gly	GTC Val	CTC Leu 670	TAC Tyr	GGC Gly	2136
ATG Met	TCG Ser	GCC Ala 675	CAC His	CGC Arg	CTC Leu	TCC Ser	CAG Gln 680	GAG Glu	CTA Leu	GCC Ala	ATC Ile	CCT Pro 685	TAC Tyr	GAG Glu	GAG Glu	2184
GCC Ala 690	CAG Gln	GCC Ala	TTC Phe	ATT Ile	GAG Glu	CGC Arg 695	TAC Tyr	TTT Phe	CAG Gln	AGC Ser	TTC Phe 700	CCC Pro	AAG Lys	GTG Val	CGG Arg	2232
GCC Ala 705	TGG Trp	ATT Ile	GAG Glu	AAG Lys	ACC Thr 710	CTG Leu	GAG Glu	GAG Glu	GGC Gly	AGG Arg 715	AGG Arg	CGG Arg	GGG Gly	TAC Tyr	GTG Val 720	2280
GAG Glu	ACC Thr	CTC Leu	TTC Phe	GGC Gly 725	CGC Arg	CGC Arg	CGC Arg	TAC Tyr	GTG Val 730	CCA Pro	GAC Asp	CTA Leu	GAG Glu	GCC Ala 735	CGG Arg	2328
GTG Val	AAG Lys	AGC Ser	GTG Val 740	CGG Arg	GAG Glu	GCG Ala	GCC Ala	GAG Glu 745	CGC Arg	ATG Met	GCC Ala	TTC Phe	AAC Asn 750	ATG Met	CCC Pro	2376
GTC Val	CAG Gln	GGC Gly 755	ACC Thr	GCC Ala	GCC Ala	GAC Asp	CTC Leu 760	ATG Met	AAG Lys	CTG Leu	GCT Ala	ATG Met 765	GTG Val	AAG Lys	CTC Leu	2424
TTC Phe 770	CCC Pro	AGG Arg	CTG Leu	GAG Glu	GAA Glu	ATG Met 775	GGG Gly	GCC Ala	AGG Arg	ATG Met	CTC Leu 780	CTT Leu	CAG Gln	GTC Val	CAC His	2472
GAC Asp 785	GAG Glu	CTG Leu	GTC Val	CTC Leu	GAG Glu 790	GCC Ala	CCA Pro	AAA Lys	GAG Glu	AGG Arg 795	GCG Ala	GAG Glu	GCC Ala	GTG Val	GCC Ala 800	2520
CGG Arg	CTG Leu	GCC Ala	AAG Lys	GAG Glu 805	GTC Val	ATG Met	GAG Glu	GGG Gly	GTG Val 810	TAT Tyr	CCC Pro	CTG Leu	GCC Ala	GTG Val 815	CCC Pro	2568

CTG GAG GTG GAG GTG GGG ATA GGG GAG GAC TGG CTC TCC GCC AAG GAG 2616
 Leu Glu Val Glu Val Gly Ile Gly Glu Asp Trp Leu Ser Ala Lys Glu
 820 825 830

TGATACCACC 2626

(2) INFORMATION FOR SEQ ID NO:2:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 832 amino acids
- (B) TYPE: amino acid
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: protein

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:2:

Met Arg Gly Met Leu Pro Leu Phe Glu Pro Lys Gly Arg Val Leu Leu
 1 5 10 15

Val Asp Gly His His Leu Ala Tyr Arg Thr Phe His Ala Leu Lys Gly
 20 25 30

Leu Thr Thr Ser Arg Gly Glu Pro Val Gln Ala Val Tyr Gly Phe Ala
 35 40 45

Lys Ser Leu Leu Lys Ala Leu Lys Glu Asp Gly Asp Ala Val Ile Val
 50 55 60

Val Phe Asp Ala Lys Ala Pro Ser Phe Arg His Glu Ala Tyr Gly Gly
 65 70 75 80

Tyr Lys Ala Gly Arg Ala Pro Thr Pro Glu Asp Phe Pro Arg Gln Leu
 85 90 95

Ala Leu Ile Lys Glu Leu Val Asp Leu Leu Gly Leu Ala Arg Leu Glu
 100 105 110

Val Pro Gly Tyr Glu Ala Asp Asp Val Leu Ala Ser Leu Ala Lys Lys
 115 120 125

Ala Glu Lys Glu Gly Tyr Glu Val Arg Ile Leu Thr Ala Asp Lys Asp
 130 135 140

Leu Tyr Gln Leu Leu Ser Asp Arg Ile His Val Leu His Pro Glu Gly
 145 150 155 160

Tyr Leu Ile Thr Pro Ala Trp Leu Trp Glu Lys Tyr Gly Leu Arg Pro
 165 170 175

Asp Gln Trp Ala Asp Tyr Arg Ala Leu Thr Gly Asp Glu Ser Asp Asn
 180 185 190

Leu Pro Gly Val Lys Gly Ile Gly Glu Lys Thr Ala Arg Lys Leu Leu
 195 200 205

Glu Glu Trp Gly Ser Leu Glu Ala Leu Leu Lys Asn Leu Asp Arg Leu
 210 215 220

Lys Pro Ala Ile Arg Glu Lys Ile Leu Ala His Met Asp Asp Leu Lys
 225 230 235 240

Leu Ser Trp Asp Leu Ala Lys Val Arg Thr Asp Leu Pro Leu Glu Val
 245 250 255

Asp Phe Ala Lys Arg Arg Glu Pro Asp Arg Glu Arg Leu Arg Ala Phe
 260 265 270
 Leu Glu Arg Leu Glu Phe Gly Ser Leu Leu His Glu Phe Gly Leu Leu
 275 280 285
 Glu Ser Pro Lys Ala Leu Glu Glu Ala Pro Trp Pro Pro Pro Glu Gly
 290 295 300
 Ala Phe Val Gly Phe Val Leu Ser Arg Lys Glu Pro Met Trp Ala Asp
 305 310 315 320
 Leu Leu Ala Leu Ala Ala Arg Gly Gly Arg Val His Arg Ala Pro
 325 330 335
 Glu Pro Tyr Lys Ala Leu Arg Asp Leu Lys Glu Ala Arg Gly Leu Leu
 340 345 350
 Ala Lys Asp Leu Ser Val Leu Ala Leu Arg Glu Gly Leu Gly Leu Pro
 355 360 365
 Pro Gly Asp Asp Pro Met Leu Leu Ala Tyr Leu Leu Asp Pro Ser Asn
 370 375 380
 Thr Thr Pro Glu Gly Val Ala Arg Arg Tyr Gly Gly Glu Trp Thr Glu
 385 390 395 400
 Glu Ala Gly Glu Arg Ala Ala Leu Ser Glu Arg Leu Phe Ala Asn Leu
 405 410 415
 Trp Gly Arg Leu Glu Gly Glu Glu Arg Leu Leu Trp Leu Tyr Arg Glu
 420 425 430
 Val Glu Arg Pro Leu Ser Ala Val Leu Ala His Met Glu Ala Thr Gly
 435 440 445
 Val Arg Leu Asp Val Ala Tyr Leu Arg Ala Leu Ser Leu Glu Val Ala
 450 455 460
 Glu Glu Ile Ala Arg Leu Glu Ala Glu Val Phe Arg Leu Ala Gly His
 465 470 475 480
 Pro Phe Asn Leu Asn Ser Arg Asp Gln Leu Glu Arg Val Leu Phe Asp
 485 490 495
 Glu Leu Gly Leu Pro Ala Ile Gly Lys Thr Glu Lys Thr Gly Lys Arg
 500 505 510
 Ser Thr Ser Ala Ala Val Leu Glu Ala Leu Arg Glu Ala His Pro Ile
 515 520 525
 Val Glu Lys Ile Leu Gln Tyr Arg Glu Leu Thr Lys Leu Lys Ser Thr
 530 535 540
 Tyr Ile Asp Pro Leu Pro Asp Leu Ile His Pro Arg Thr Gly Arg Leu
 545 550 555 560
 His Thr Arg Phe Asn Gln Thr Ala Thr Ala Thr Gly Arg Leu Ser Ser
 565 570 575
 Ser Asp Pro Asn Leu Gln Asn Ile Pro Val Arg Thr Pro Leu Gly Gln
 580 585 590
 Arg Ile Arg Arg Ala Phe Ile Ala Glu Glu Gly Trp Leu Leu Val Ala
 595 600 605

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Leu Asp Tyr Ser Gln Ile Glu Leu Arg Val Leu Ala His Leu Ser Gly
 610 615 620
 Asp Glu Asn Leu Ile Arg Val Phe Gln Glu Gly Arg Asp Ile His Thr
 625 630 635 640
 Glu Thr Ala Ser Trp Met Phe Gly Val Pro Arg Glu Ala Val Asp Pro
 645 650 655
 Leu Met Arg Arg Ala Ala Lys Thr Ile Asn Phe Gly Val Leu Tyr Gly
 660 665 670
 Met Ser Ala His Arg Leu Ser Gln Glu Leu Ala Ile Pro Tyr Glu Glu
 675 680 685
 Ala Gln Ala Phe Ile Glu Arg Tyr Phe Gln Ser Phe Pro Lys Val Arg
 690 695 700
 Ala Trp Ile Glu Lys Thr Leu Glu Glu Gly Arg Arg Arg Gly Tyr Val
 705 710 715 720
 Glu Thr Leu Phe Gly Arg Arg Arg Tyr Val Pro Asp Leu Glu Ala Arg
 725 730 735
 Val Lys Ser Val Arg Glu Ala Ala Glu Arg Met Ala Phe Asn Met Pro
 740 745 750
 Val Gln Gly Thr Ala Ala Asp Leu Met Lys Leu Ala Met Val Lys Leu
 755 760 765
 Phe Pro Arg Leu Glu Glu Met Gly Ala Arg Met Leu Leu Gln Val His
 770 775 780
 Asp Glu Leu Val Leu Glu Ala Pro Lys Glu Arg Ala Glu Ala Val Ala
 785 790 795 800
 Arg Leu Ala Lys Glu Val Met Glu Gly Val Tyr Pro Leu Ala Val Pro
 805 810 815
 Leu Glu Val Glu Val Gly Ile Gly Glu Asp Trp Leu Ser Ala Lys Glu
 820 825 830

(2) INFORMATION FOR SEQ ID NO:3:

- (i) SEQUENCE CHARACTERISTICS:
- (A) LENGTH: 39 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: single
 - (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:3:

GGGTCCACGG CCTCCCGCGG GACGCCGAAC ATCCAGCTG

39

(2) INFORMATION FOR SEQ ID NO:4:

- (i) SEQUENCE CHARACTERISTICS:
- (A) LENGTH: 16 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: single
 - (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:4:

GGACTGCATA TGA CTG

16

(2) INFORMATION FOR SEQ ID NO:5:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 22 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: single
 - (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:5:

CTAGCAGTCA TATGCAGTCC GC

22

(2) INFORMATION FOR SEQ ID NO:6:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 80 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: single
 - (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:6:

CGGGAGGCCG TGGACCCCCT GATGCGCCGG GCGGCCAAGA CCATCAACTT CGGGGTCCTC
TACGGCATGT CGGCCACCG

60

80

(2) INFORMATION FOR SEQ ID NO:7:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 37 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: single
 - (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:7:

TGGCTAGCTC CTGGGAGAGG CGGTGGGCCG ACATGCC

37

(2) INFORMATION FOR SEQ ID NO:8:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 32 base pairs
 - (B) TYPE: nucleic acid
 - (C) STRANDEDNESS: single
 - (D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:8:

TTCGGCGTCC CGCGGGAGGC CGTGGACCCC CT

32

(2) INFORMATION FOR SEQ ID NO:9:

- (i) SEQUENCE CHARACTERISTICS:
 - (A) LENGTH: 24 base pairs
 - (B) TYPE: nucleic acid

(C) STRANDEDNESS: single
(D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:9:

GTAAGGGATG GCTAGCTCCT GGGA

24

(2) INFORMATION FOR SEQ ID NO:10:

- (i) SEQUENCE CHARACTERISTICS:
(A) LENGTH: 14 base pairs
(B) TYPE: nucleic acid
(C) STRANDEDNESS: single
(D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:10:

CGCGCCGAAT TCCC

14

(2) INFORMATION FOR SEQ ID NO:11:

- (i) SEQUENCE CHARACTERISTICS:
(A) LENGTH: 46 base pairs
(B) TYPE: nucleic acid
(C) STRANDEDNESS: single
(D) TOPOLOGY: linear

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:11:

GCGCGGAAGC TTGGCTGCAG AATATTGCTA GCGGGAATTC GGCGCG

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